THE CONTENTS OF THIS SECTION ARE
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INITIAL KH DATE 8/10/04

PROPERTY OF DURATEK INC. AND ITS SUBSIDIARIES

DESIGN DOCUMENT COVER SHEET

DOCUMENT ID NUMBER: ST-468 REVISION NUMBER: 0

PROJECT NUMBER: RP0003

SECURITY STATUS: PROPRIETARY: ______ NON-PROPRIETARY: X

RETENTION PERIOD: Life of the Project + 1 Year

TITLE: **Finite Element Analysis of the INEEL PM-2A Holding Tanks**

PREPARED BY: [signature] DATE: 05-19-2004

TITLE: Principal Engineer

REVIEWED BY: [signature] DATE: 5/21/04

TITLE: Chief Engineer

REVISION NOTES:

DOCUMENT CONTROL

Received By: [signature] Date: 5/21/04

Document Dated From: 5/19/04 To: 5/21/04

Verification to Index By: [initials] (31-pages) Date 5/21/04

Storage Shelf Location: DCC-4-A

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DESIGN DOCUMENT REVIEW CHECKLIST

Document ID No.: ST-468 Revision No.: 0

Date: 5/21/04

ITEM	YES	N/A*
1. The purpose or objective is clear and consistent with the analysis.	√	
2. Design Inputs such as design bases, regulatory requirements, codes, and standards are identified and documented.	√	
3. Effect of design package on compliance with the Safety Analysis Report or Certificate of Compliance identified and documented.		√
4. References are complete and accurate.	√	
5. Latest version of the drawings is used, and the revision numbers are correct on the list of drawings.	√	
6. Assumptions are reasonable, and the list of assumptions is complete and appropriate.		√
7. Assumptions that must be verified as the design proceeds have appropriately identified.		√
8. Analysis methodology is appropriate, and correct analysis method used.	√	
9. Correct values used from drawings?	√	
10. Answers and units correct?	√	
11. Summary of results matches calculations?	√	
12. Material properties properly taken from credible references?	√	
13. Figures match design drawings?	√	
14. Computer input complete and properly identified?	√	
15. Conclusions are consistent with the analysis results.	√	
16. Documentation of all hand calculations attached?	√	
17. Meeting minutes of the Design Review?		√

* Not Applicable, Explain

3. There is no Safety Analysis Report or Certificate of Compliance for this equipment.
6. No major assumptions that needed verification were made.
7. This document presents the evaluation of the final design.
17. No design review meeting is needed for this equipment.

Independent Reviewer Irfan Baig

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DESIGN DOCUMENT REVIEW METHOD CHECKLIST

Document ID No.: ST-468 Revision No.: 0

Date: 5/21/04

ITEM		
1.	Alternate or simplified computational method.	✓
2.	Comparison of results to other calculations of a similar nature.	
3.	Numerical repetition of the calculations.	√
4.	Comparison of calculations with experimental results.	
5.	Other (specify)	
6.	Comments:	

Independent Reviewer Irfan Baig

PROPERTY OF DURATEK INC. AND ITS SUBSIDIARIES

DESIGN DOCUMENT CERTIFICATION

Document ID No.:	ST-468	Revision No.:	0
Date:	5/21/2004		

I, Mirza I. Baig, a licensed Professional Engineer in the state of New Jersey (License No. 24GE02674000), experienced in the design and analysis of structural components, certify that the analyses performed in this document is based on sound engineering principles and practices. Competent engineers, proficient in the discipline of structural engineering, have performed these analyses under my supervision.

STATE OF NEW JERSEY
MIRZA I. BAIG
No. GE26740
LICENSED
PROFESSIONAL ENGINEER

1.0 OBJECTIVE

Finite element analysis of the INEEL PM-2A holding tank shells for the expected loading under lifting of the holding tank and on-site transportation.

2.0 INTRODUCTION

Two 55,000-gallon INEEL PM-2A holding tanks (Tank # V-13 and V-14) will be lifted and transported on the road at the site. Attachment 1 of this document provides the general arrangement details for these holding tanks, and Attachment 2 of this document provides the typical installed configuration details of these holding tanks. This document presents the finite element analysis of a typical holding tank shell to demonstrate the compliance with the requirements of Reference 1 for the following load cases:

2.1 Lifting (Figures 1 and 11)

Evaluation is performed for the loads that are exerted on the holding tank under the lifting condition. For lifting of each holding tank, eight pads with lift lugs will be welded to the upper surface of the holding tank per Reference 2 drawing. Ropes and spreader bars as shown in Figure 11 will be used to lift the holding tank. The holding tank design lift weight of 147,500 lbs., calculated in Reference 6 document, is based on Portage Environmental document PEI-EDF-1006 (Reference 7).

2.2 Holding tank placement on saddles (Figure 2)

Evaluation is performed for the loads that are exerted on the holding tank shell while the tank is resting on the two saddles. Each holding tank will be placed on the saddles per Reference 3 drawing. The saddle details are per Reference 4.

2.2.1 Tank on saddles during on-site transportation

Using the summary of component weight of Reference 6, a holding tank design weight of 125,000 lbs. is considered for this load case. This document also refers to this load case as the unprocessed waste load case.

2.2.2 Tank on saddles during decontamination and decommissioning

The holding tank design weight for this load case is 216,000 lbs. (Reference 6). This document also refers to this load case as the processed waste load case.

Analyses are performed using ANSYS (Reference 5) finite element computer program to demonstrate the compliance with Reference 1 requirements.

Each holding tank is a horizontal circular cylindrical in shape and is nominally made of 5/8" thick carbon steel shell (Attachments 1 and 2). Considering corrosion allowance, a conservative 3/8" thick longitudinal shell is used for the finite element evaluations. The holding tank domes at each end are also modeled as 3/8" thick elliptical head.

3.0 REFERENCES

(1) AISC Steel Construction Manual, Allowable Stress Design, Ninth Edition.

(2) Duratek Drawing No. C-067-RP0003-004, Rev.1, "INEEL PM-2A Tank Lift Lug Weldment Details."

(3) Duratek Drawing No. C-067-RP0003-003, Rev.2, "INEEL PM-2A Tank Site Transportation and Hardware."

(4) Duratek Drawing No. C-067-RP0003-006, Rev.1, "Saddle Detail."

(5) ANSYS Revision 7.1, ANSYS Inc., Canonsburg, Pennsylvania, 2003.

(6) Duratek Document ST-467, Rev. 0, "Supporting Calculations for the INEEL Tanks Lifting and On Site Transportation."

(7) Portage Environmental Document ID "PEI-EDF-1006", Rev. 0, "PM-2A Tank Weight Evaluation."

4.0 MATERIAL PROPERTIES

Structural Steel

Specification: ASTM A-36

Minimum Yield Strength, S_y = 36,000 psi

Minimum Ultimate Strength, S_u = 58,000 psi

5.0 ALLOWABLE STRESSES

The allowable stresses are per Reference 1 using the material properties specified in Section 4.0.

ASTM A-36 Steel

Allowable Plate Bending Stress, $= 0.75\ S_y$

$= 0.75 \times 36$ ksi

$= 27$ ksi

6.0 STRUCTURAL ANALYSES

6.1 Lifting

An ANSYS finite element model is prepared for the analysis of the holding tank shell under the applied loading. The model depicts the holding tank longitudinal shell with a dome at each end.

Due to the existence of a plane of symmetry, a 180° segment (half-model) with appropriate boundary conditions along the plane of symmetry is considered for the analysis.

The model uses 3/8" thick 4-node finite strain shell elements (ANSYS SHELL181) for the holding tank longitudinal body and for the dome ends, ¾" thick 4-node finite strain shell elements (ANSYS SHELL181) to model the 20" square pads and 1" thick 4-node finite strain shell elements (ANSYS SHELL181) to model the lift lugs. Weight density of the elements has been adjusted as needed to account for the sludge on the bottom and for the model to yield a lift weight close to the 147,500 lbs design lift weight (Reference 6). From the reaction solution listing provided below, total algebraic sum of all the applied upward loads (4 x 20, 467 x Cos 25˚ = 74,198 lbs.) and the downward weigh component is essentially zero, which means that the applied load is in equilibrium with the body weight.

```
***** POST1 TOTAL REACTION SOLUTION LISTING *****

LOAD STEP=     1  SUBSTEP=     1
TIME=    1.0000      LOAD CASE=   0

THE FOLLOWING X,Y,Z SOLUTIONS ARE IN GLOBAL COORDINATES


NODE      FX          FY          FZ          MX          MY          MZ

TOTAL VALUES
VALUE    34599.      1.7160      0.0000      180.68     -1553.9    -0.105
```

Equal cable lift loads of 20,467 lbs. are applied at 25˚ from vertical to the lugs located at nodes 2772, 3008, 3212 and 3416 of the half-model.

Figure 3 shows the model, the boundary conditions and the applied loading used in the analysis. Figure 4 adds a side view of the model to what was shown in Figure 3. Figure 5 shows the enlarged view of the model for the 1" thick lift lug and the ¾" thick lug mounting pad. Figure 6 give the maximum stress intensity for the holding tank shell for this loading (SMX = 22,719 psi). Figure 6 also provides the maximum displacement of the holding tank under lift loading (DMX = 2.729").

SMX = 22,719 psi < 27,000 psi O.K.

This stress value (22,719 psi) compares well with the (22,141 psi) combined shell stress calculated using the closed-form solution in Reference 6.

Figure 7 gives the maximum stress intensity (SMX) for the holding tank lift lug and the lug mounting pad assembly for lift loading. SMX = 14,244 psi and it occurs at corner of the mounting pad.

SMX = 14,244 psi < 27,000 psi O.K.

The lift lug local stresses are evaluated in Reference 6 document.

The model nodal coordinates, element and material information, boundary conditions, gravity loading along with the nodal displacement, nodal and the reaction solutions are included in Attachment - 3.

6.2 Tank placement on two saddles

6.2.1 Tank on saddles during on-site transportation

An ANSYS finite element model is prepared for the analysis of the holding tank shell under the applied loading. The model depicts the holding tank longitudinal shell with a dome at each end. Due to the existence of two planes of symmetry, a 180° segment (quarter-model) with appropriate boundary conditions along the two planes of symmetry is considered for the analysis.

The model uses 3/8" thick 4-node finite strain shell elements (ANSYS SHELL181) for the holding tank longitudinal body and for the dome ends. Weight density of the elements has been adjusted as needed to account for the sludge on the bottom and for the model to yield a conservative holding tank weight. From the reaction solution listing provided below, the calculated holding tank weight = 31,465 x 4 = 125,860 lbs. is larger than the holding tank design weight of 125,000 lbs. (Section 2.2.2), hence the holding tank shell stress values calculated using the finite element analysis are conservative.

```
***** POST1 TOTAL REACTION SOLUTION LISTING *****

  LOAD STEP=     1  SUBSTEP=     1
   TIME=    1.0000      LOAD CASE=   0

  THE FOLLOWING X,Y,Z SOLUTIONS ARE IN GLOBAL COORDINATES

    NODE      FX          FY          FZ          MX          MY          MZ

 TOTAL VALUES
 VALUE  -0.71623E-08  31465.    -0.13423E-06  51.945      238.85     -16248.
```

The model is restrained where the holding tank shell makes contact with the saddle cradle. Nodal restrains in the radial direction (UX) are provided for the appropriate nodes in this area. The maximum shell stress intensity from the finite element analysis is:

SMX = 16,732 psi < 27,000 psi O.K.

Figure 8 shows the model and the boundary conditions used in the analysis. Figure 9 give the maximum stress intensity for the holding tank for this loading (SMX = 16,732 psi). Figure 9 also provides the maximum displacement of the holding tank under this loading (DMX = 0.294444"). Note that a large scale-factor was selected so that the holding tank deformed shape is clearly shown.

The model nodal coordinates, element and material information, boundary conditions, gravity loading along with the nodal displacement, nodal and the reaction solutions are included in Attachment - 4.

6.2.2 Tank on saddles during decontamination and decommissioning

The ANSYS finite element model used in Section 6.2.1 is utilized for the evaluations here. Weight density of the elements has been adjusted as needed to account for the sludge on the bottom and for the model to yield a conservative holding tank weight. From the reaction solution listing provided below, the calculated holding tank weight = 55,034 x 4 = 220,136 lbs. is larger than the holding tank design weight of 216,000 lbs. (Reference 6), hence the holding tank shell stress values calculated using the finite element analysis are conservative.

```
***** POST1 TOTAL REACTION SOLUTION LISTING *****

LOAD STEP=     1  SUBSTEP=     1
TIME=    1.0000      LOAD CASE=   0

THE FOLLOWING X,Y,Z SOLUTIONS ARE IN GLOBAL COORDINATES

NODE      FX          FY          FZ          MX          MY          MZ

TOTAL VALUES
VALUE  -0.61015E-08  55034.    -0.20286E-06  105.85      232.00     -23358.
```

The model is restrained where the holding tank shell makes contact with the saddle cradle. Nodal restrains in the radial direction (UX) are provided for the appropriate nodes in this area. The maximum shell stress intensity from the finite element analysis is:

SMX = 24,403 psi < 27,000 psi O.K.

The above conservative stress intensity value (24,403 psi) compares well with the 20,202 psi of Reference 6. Since the holding tank content (sludge) will only exist over a small area at the bottom of the holding tank the 20,202 psi is a more realistic representation of the shell circumferential stress at horn of the saddle, which is less than the 27,000 psi allowable stress value. Figure 8 shows the model and the boundary conditions used in this analysis. Figure 10 give the maximum stress intensity for the holding tank for this loading (SMX = 24,403 psi). Figure 10 also provides the maximum displacement of the holding tank under this loading (DMX = 0.359067”). Note that a large scale-factor was selected so that the holding tank deformed shape is clearly shown.

The model nodal coordinates, element and material information, boundary conditions, gravity loading along with the nodal displacement, nodal and the reaction solutions are included in Attachment - 5.

7.0 DISCUSSION ON FEA RESULTS

The maximum stress intensities reported in Table 1 are based on the finite element analysis of the holding tank with an assumed minimum thickness of 3/8” every where in its shell.
The allowable stresses and the margins of safety reported in the table are based on the American Institute of Steel Construction, Inc. (AISC) Allowable Stress Design Manual. These allowable values include a margin of safety of 33% over the yield stress of the material. Failure of the components does not occur well beyond these allowable stresses. However, due to various uncertainties involved in the PM-2A holding tank’s material and geometry, Duratek does not recommend exceeding the AISC allowable stresses in the holding tank under any loading conditions. Therefore, a minimum thickness of 3/8” in the holding tank wall needs to be established by suitable NDE/UT methods, prior to lifting the holding tanks.

Table 1

PM-2A Holding Tanks FEA Result Summary

Loading Condition	Maximum Mass (lb)	Maximum Stress Intensity(1) (psi)	Allowable Stress Intensity(2) (psi)	Margin of Safety(3) (%)
Lifting	147,500	22,719	27,000	18.8
Saddle Loading (Unprocessed Waste)	125,000	16,732	27,000	61.4
Saddle Loading (Processed Waste)	216,000	24,403	27,000	10.6

Notes:

(1) Maximum stress intensity occurs in the holding tank shell under all the loading conditions.

(2) Allowable stress based on the American Institute of Steel Construction, Inc. (AISC) Allowable Stress Design Manual.

(3) Margin of Safety is defined as:

M.S. = {(allowable S.I. – maximum S.I.)/(maximum S.I.)}×100 %

It is a measure of the margin in the design over the established allowable stress intensity.

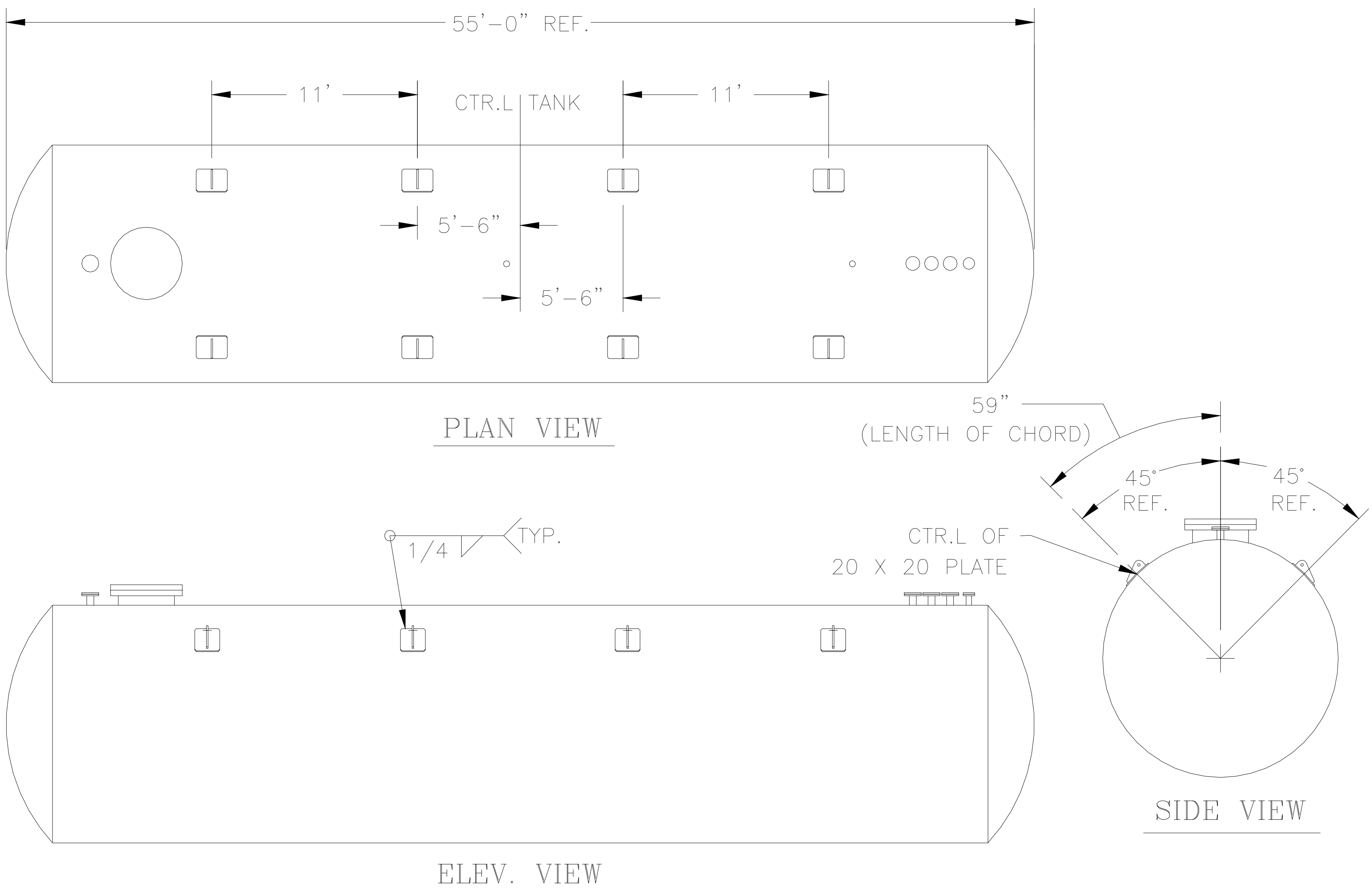


Figure 1: Location of the PM-2A Holding Tank Lifting Attachments

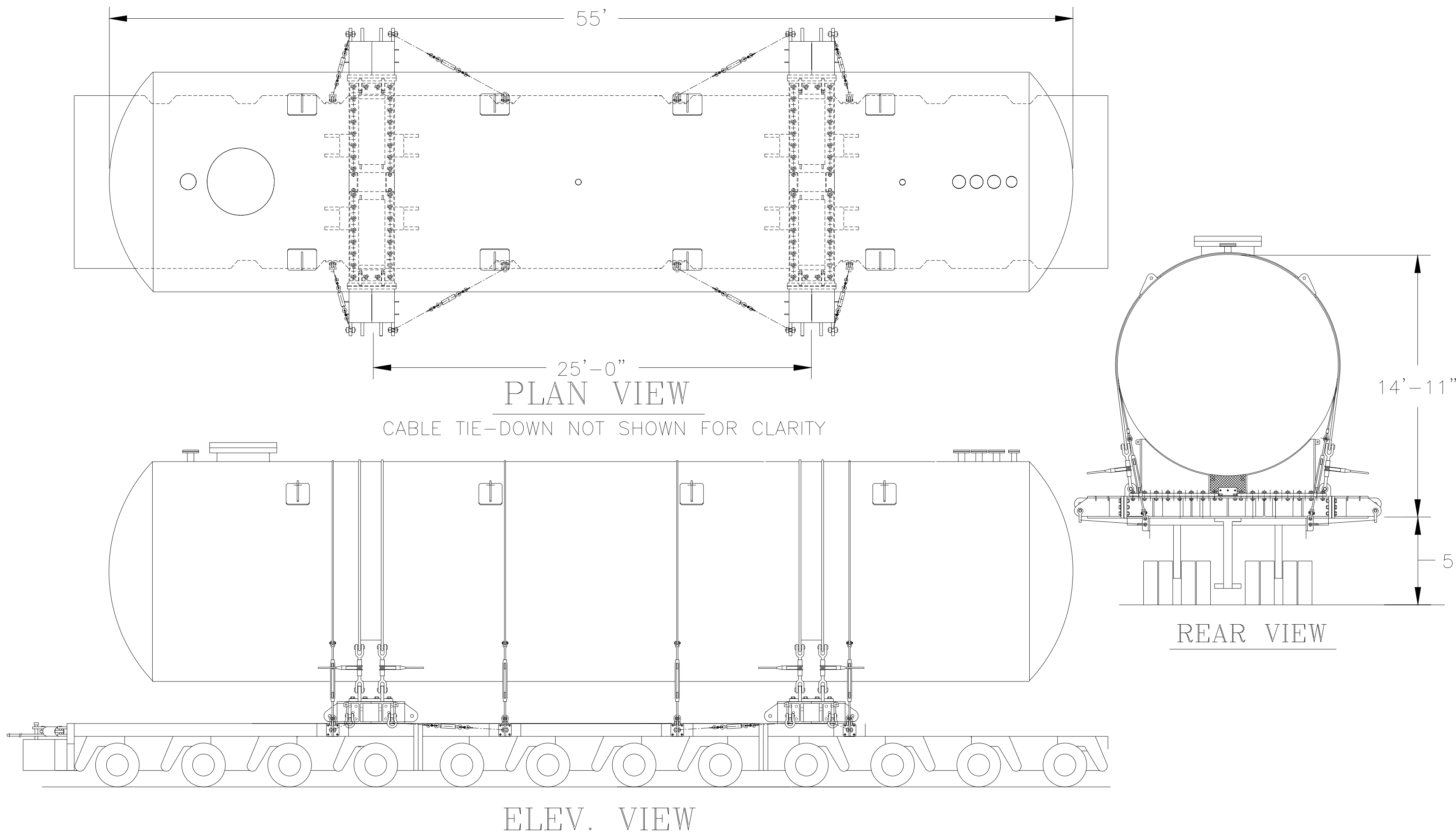


Figure 2: Arrangement of the PM-2A Holding Tank on Saddles

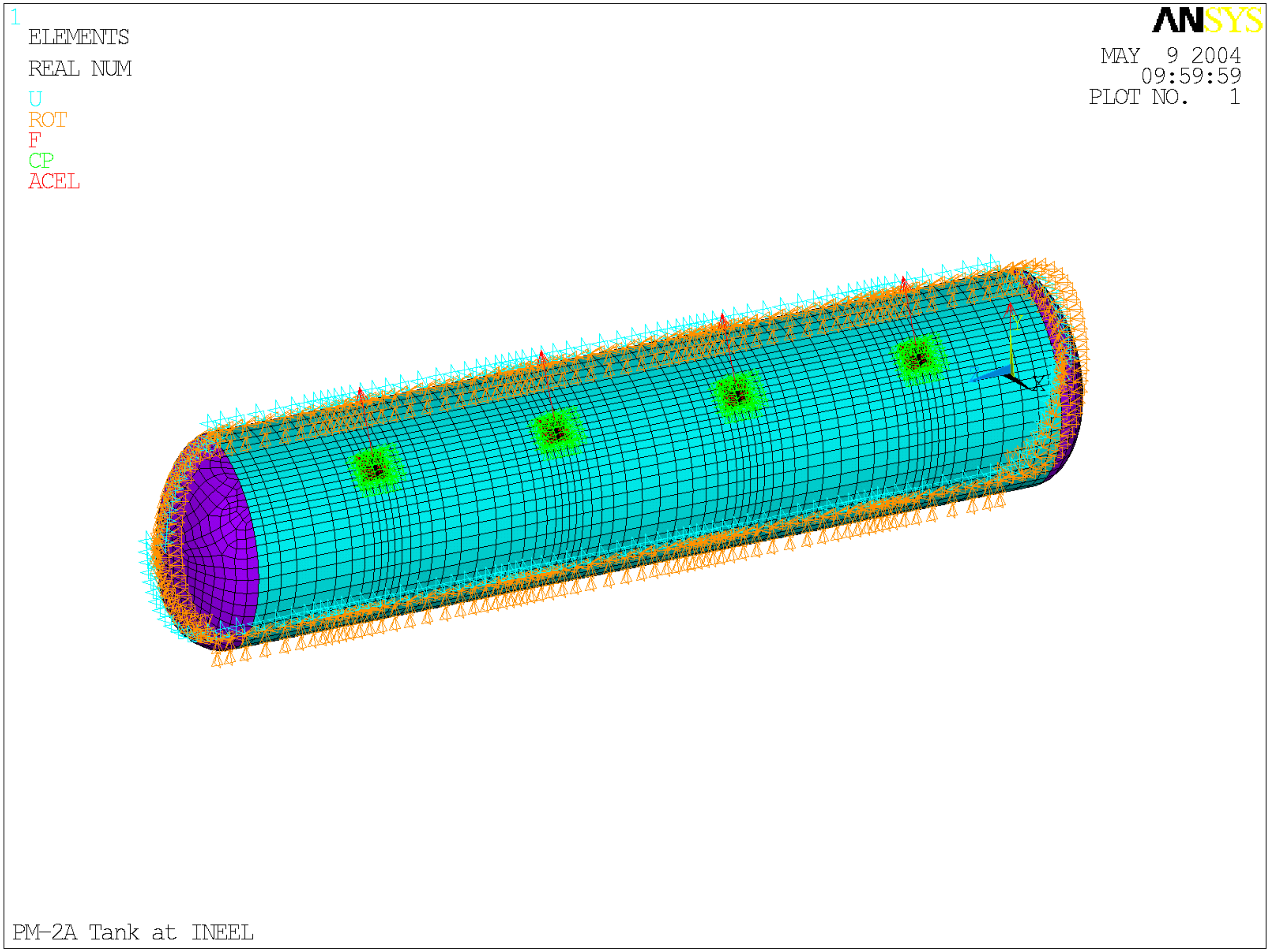


Figure 3: Finite Element Model of the PM-2A Holding Tank – Lifting

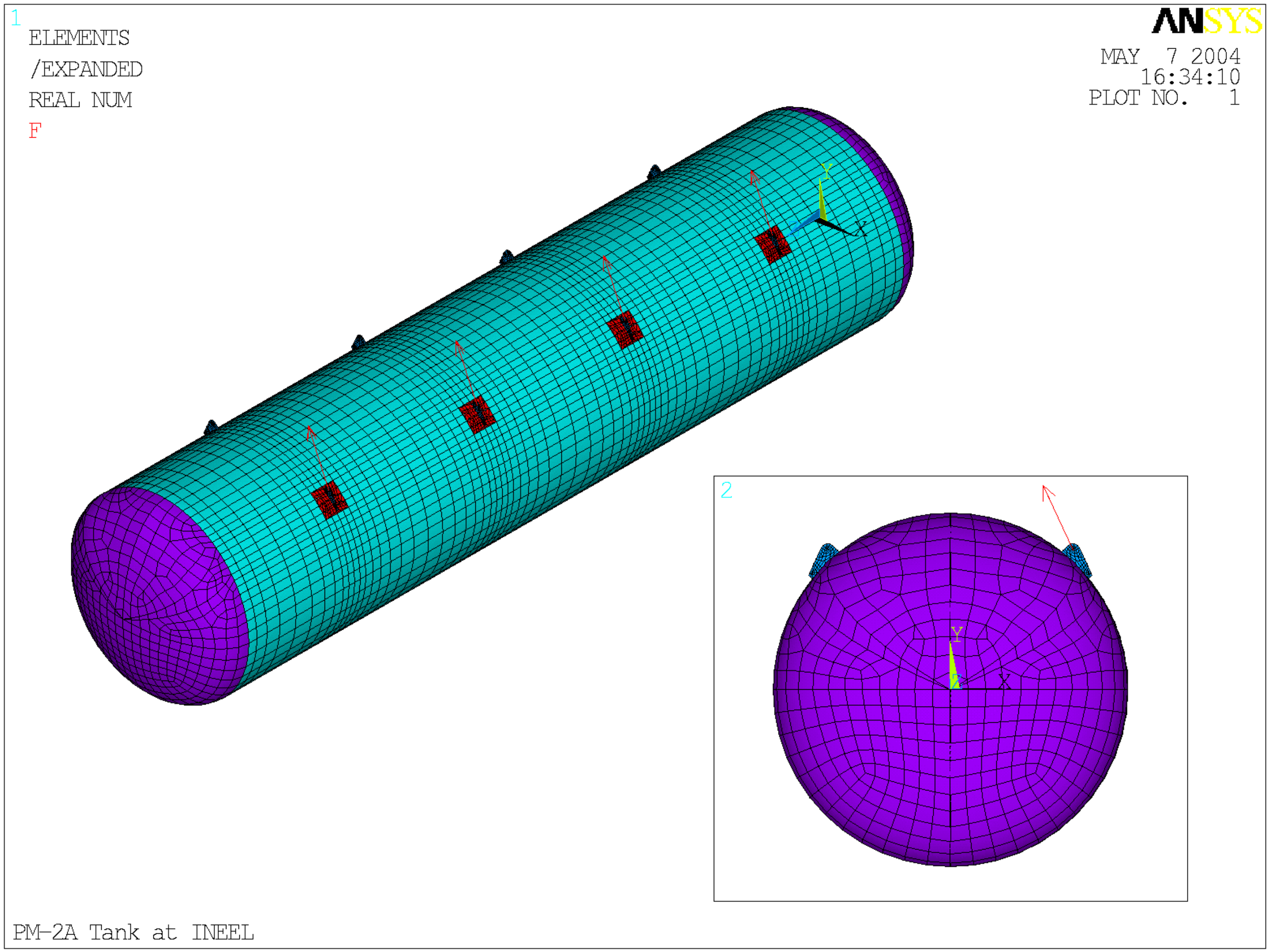


Figure 4: Finite Element Model of the PM-2A Holding Tank – Showing the Side View

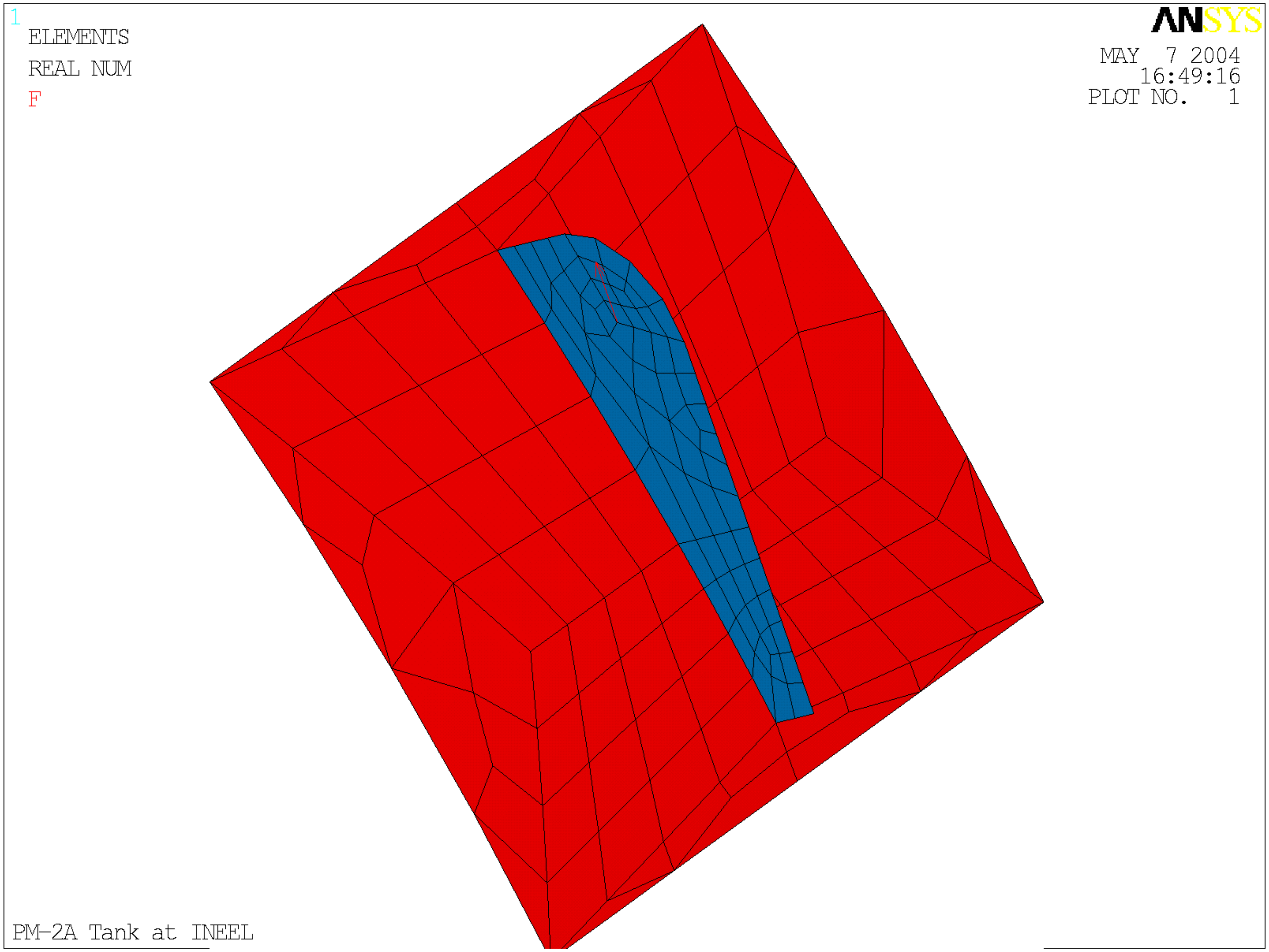


Figure 5: Finite Element Model of the PM-2A Holding Tank – Showing the Lug and Pad Details

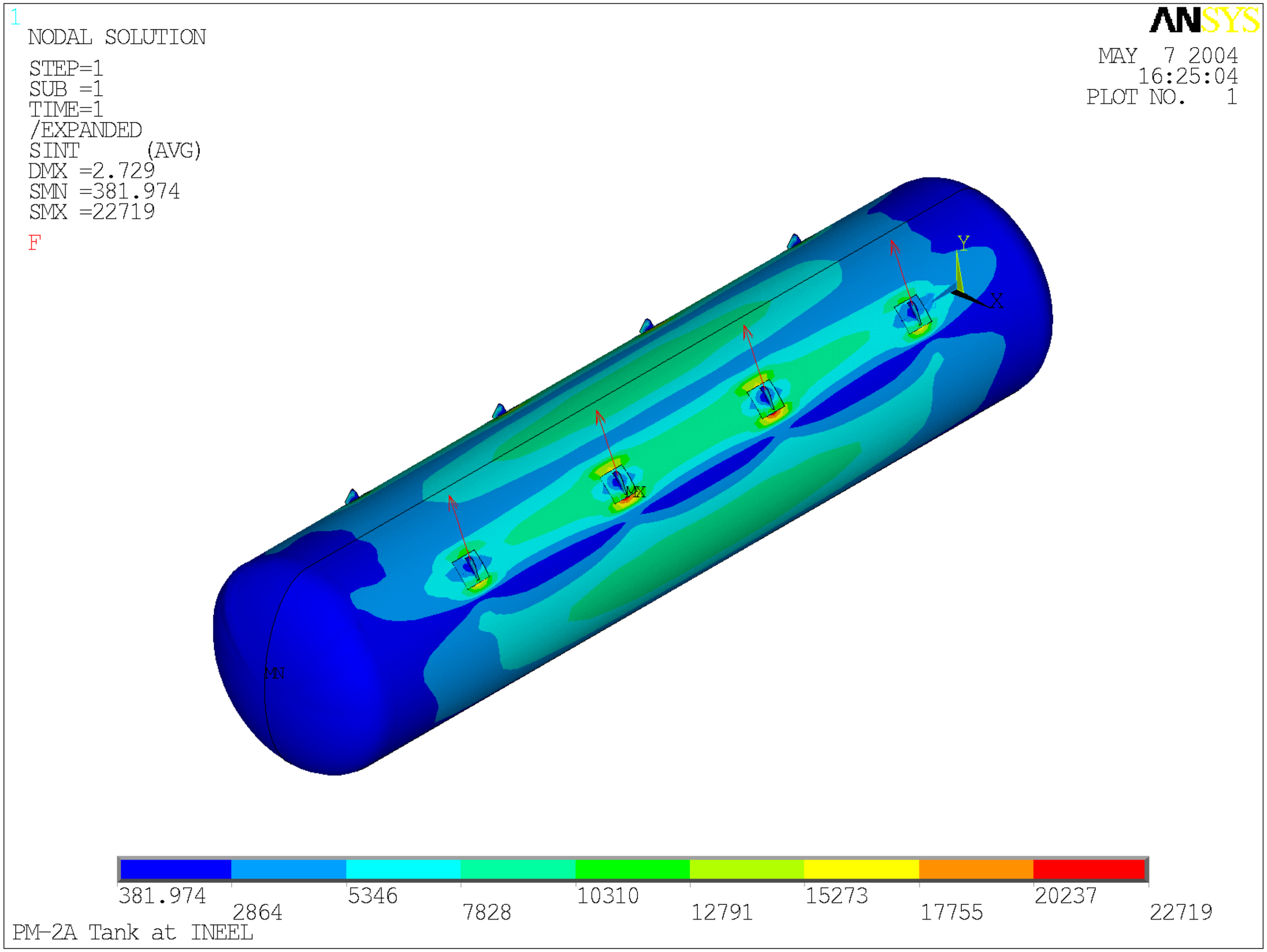


Figure 6: Stress Intensities in the PM-2A Holding Tank Under Lifting Loading

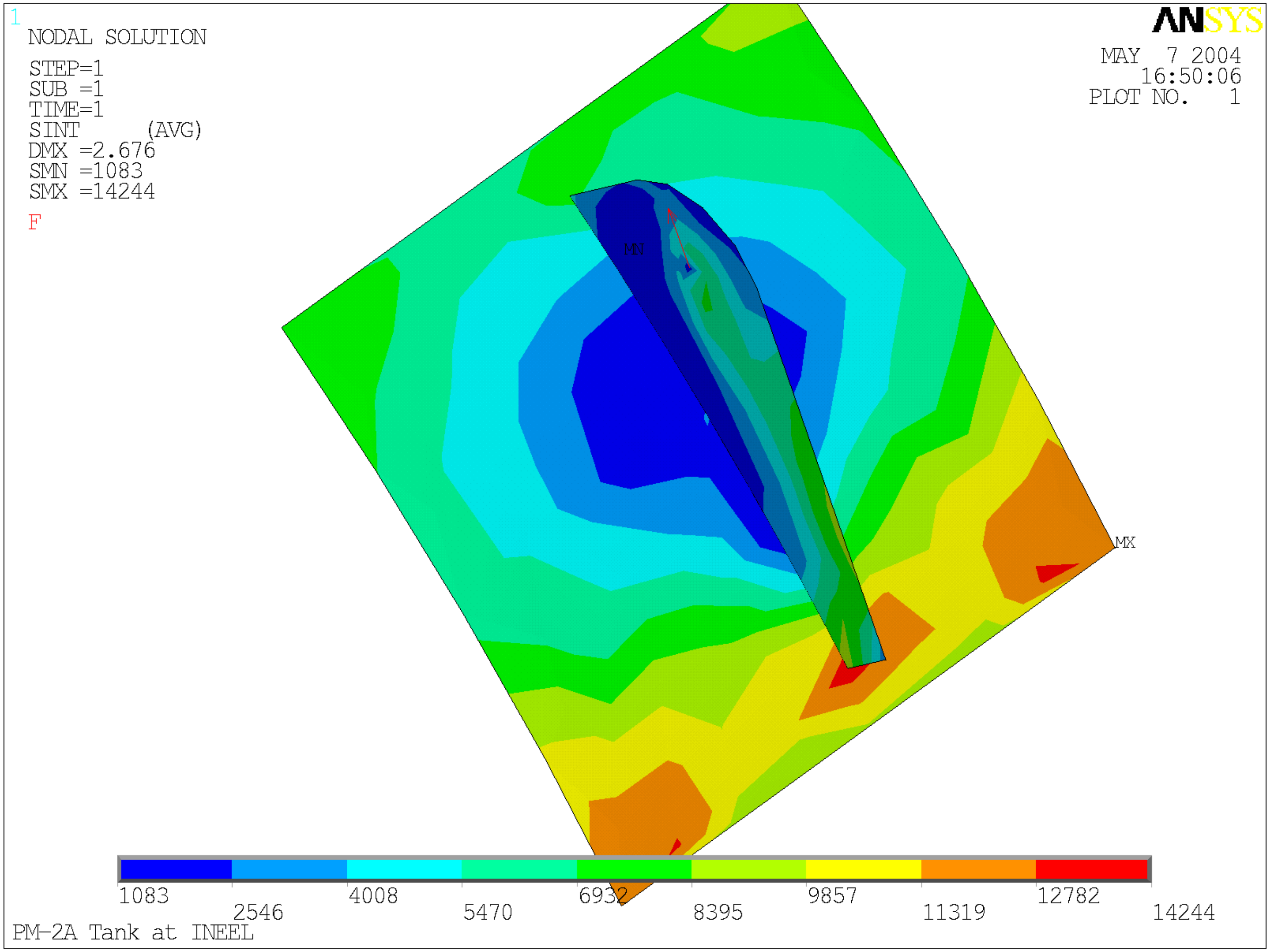


Figure 7: Stress Intensities in the Lugs and Reinforcement Pads of the PM-2A Holding Tank Under Lifting Loading

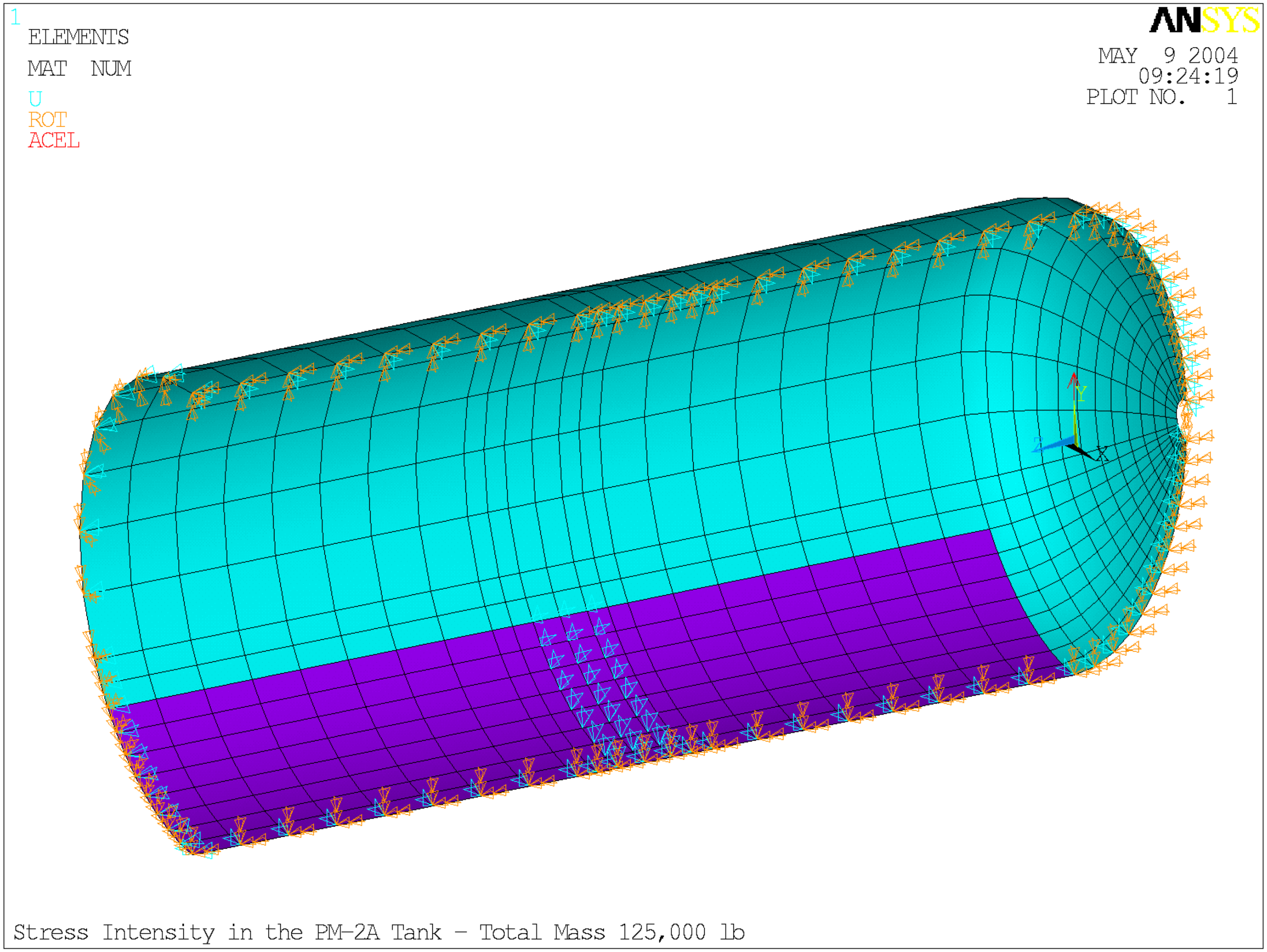


Figure 8: Finite Element Model Of the PM-2A Holding Tank – Saddle Loading

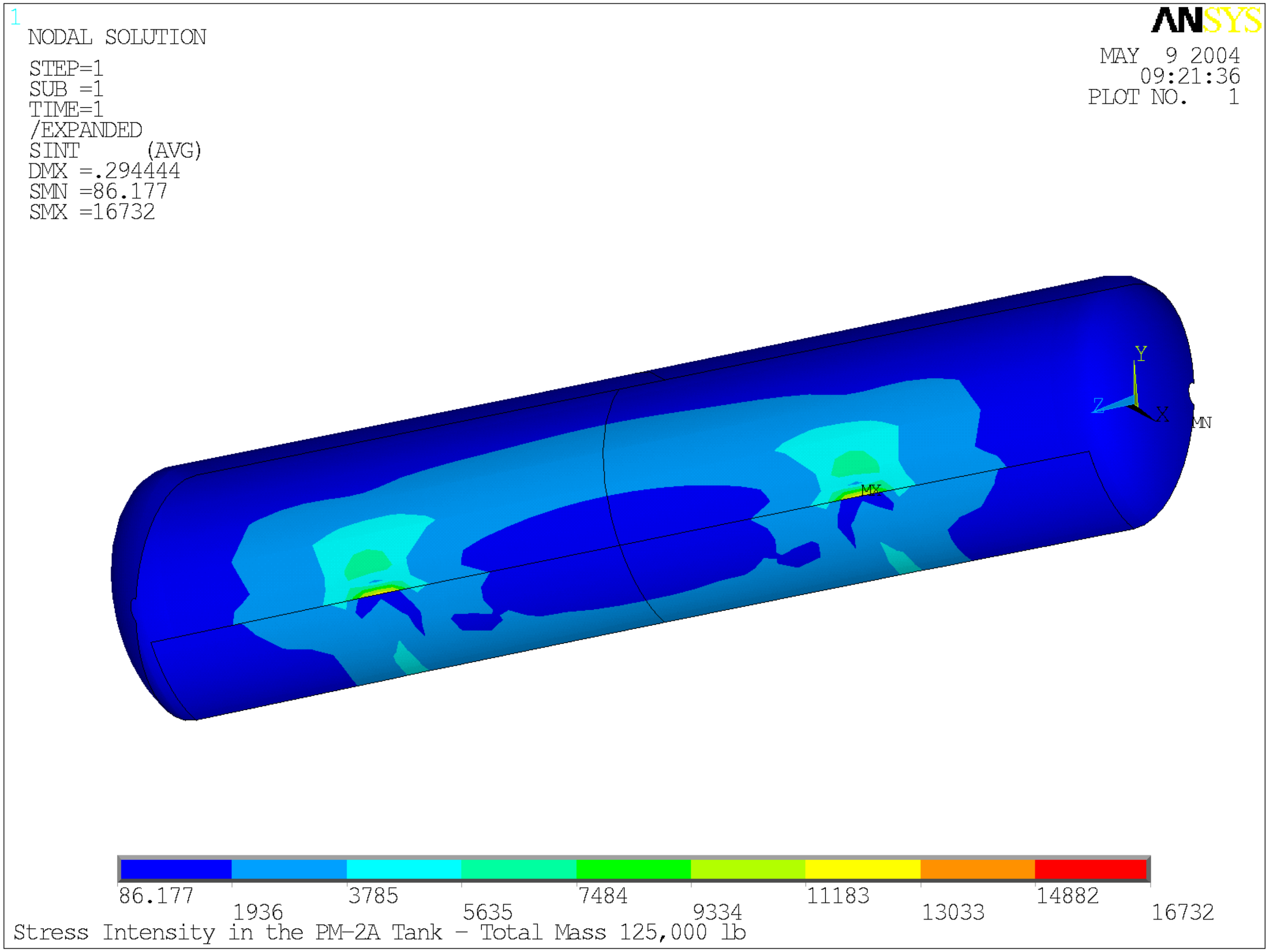


Figure 9: Stress Intensities in the PM-2A Holding Tank – Saddle Loading (Total Mass 125,000 lb)

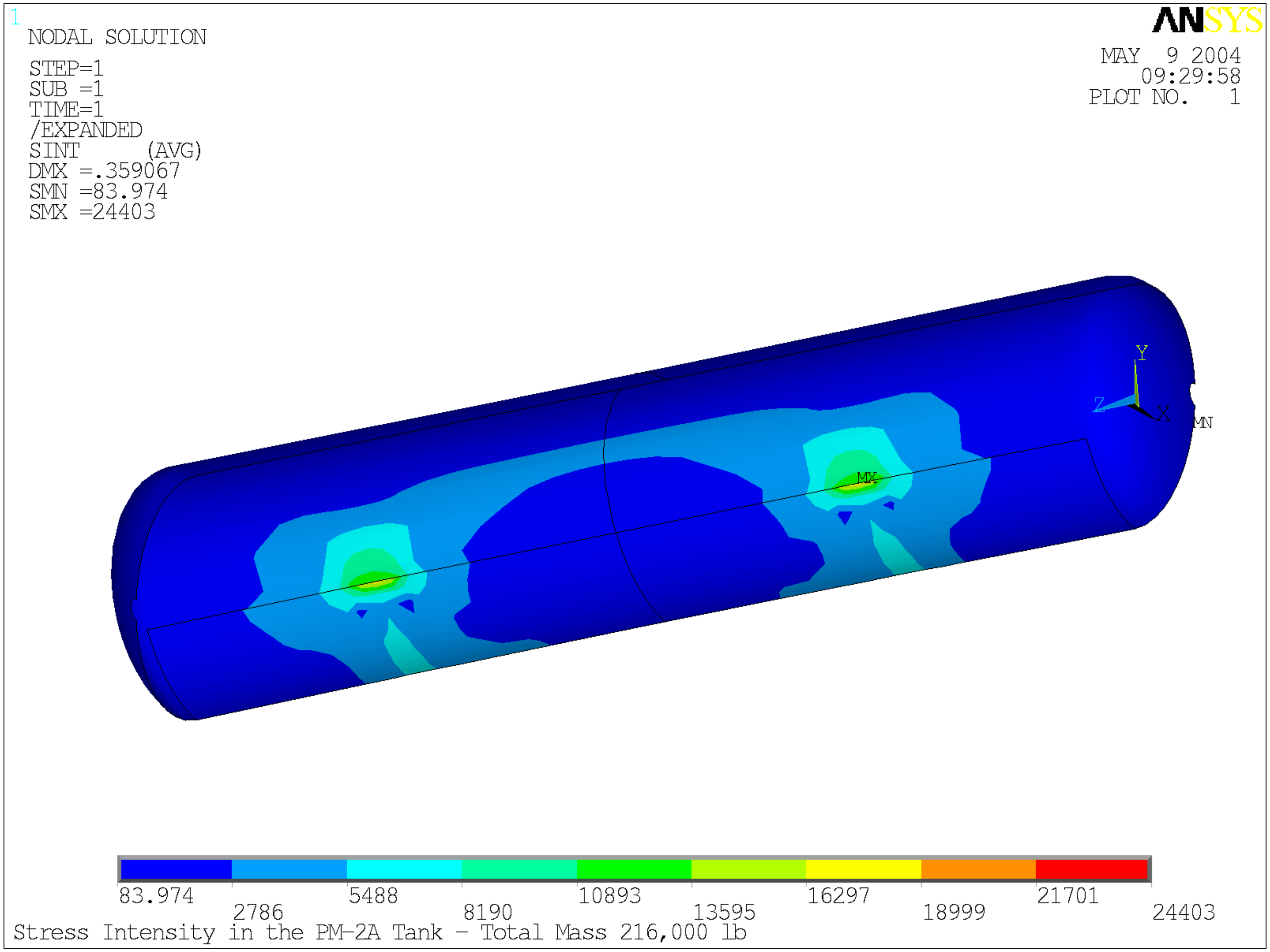


Figure 10: Stress Intensities in the PM-2A Holding Tank – Saddle Loading (Total Mass 216,000 lb)

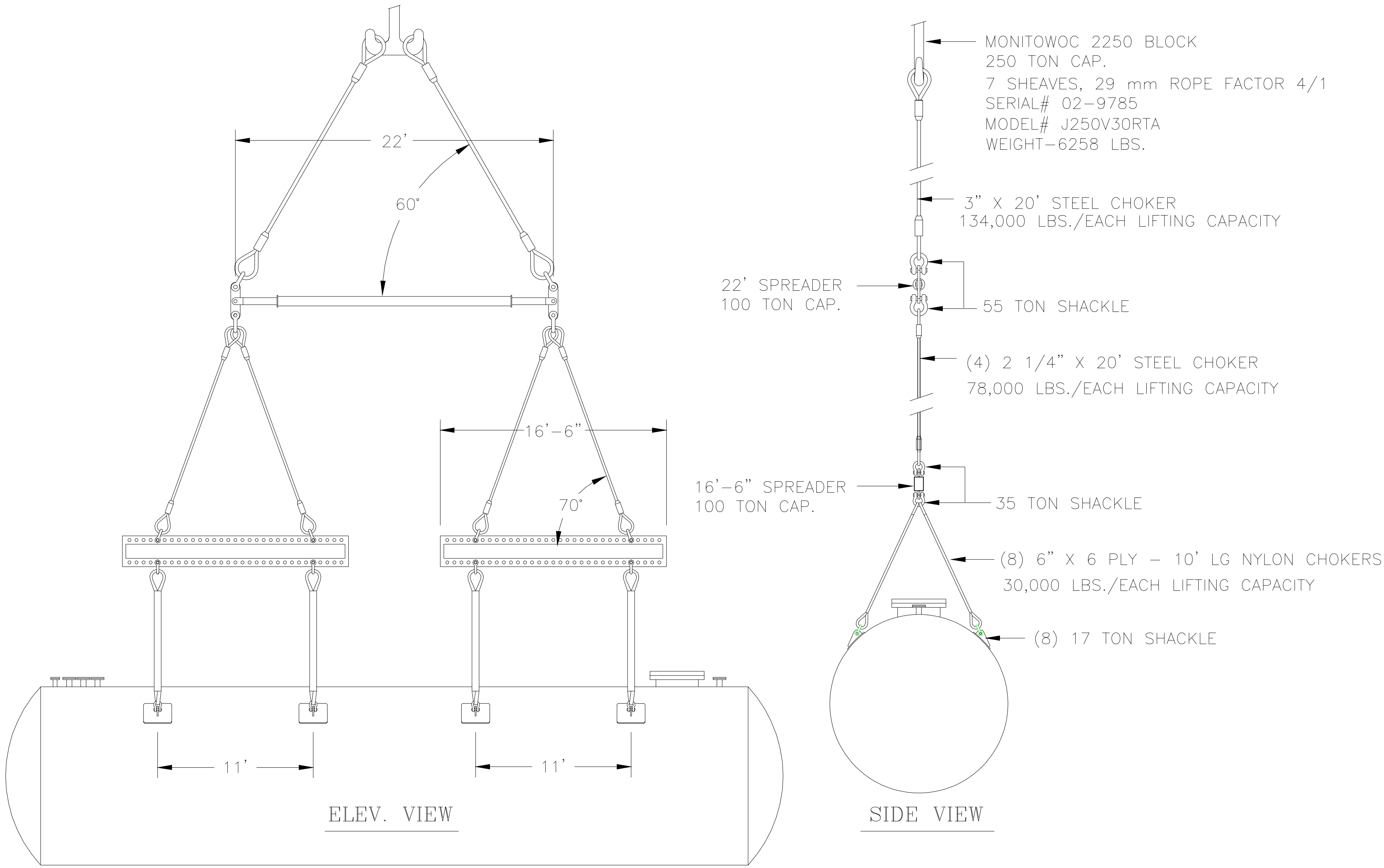
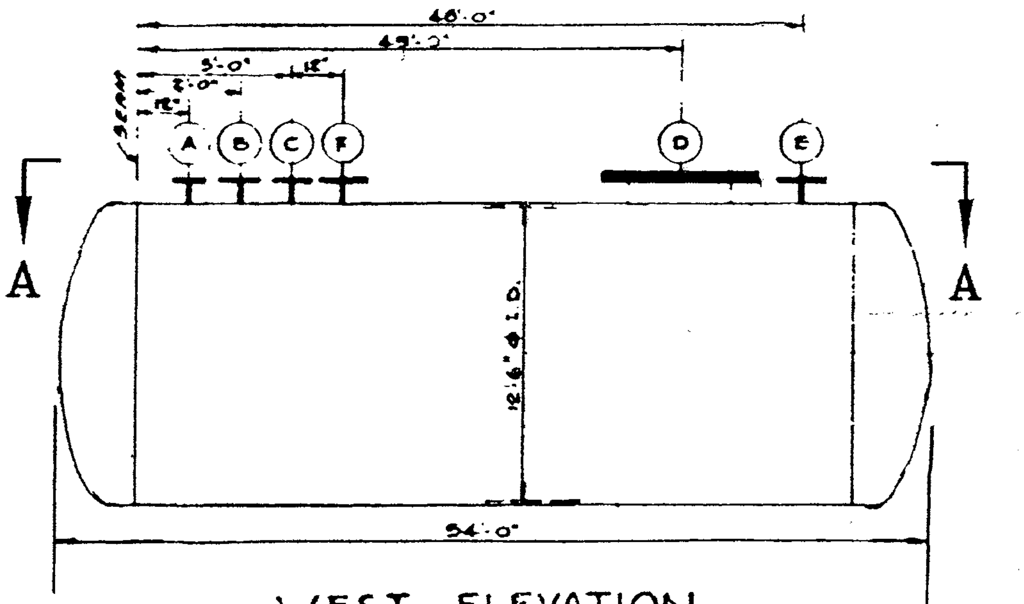


Figure 11: Lifting Details for a Typical PM-2A Holding Tank

ATTACHMENT NO. – 1

Holding Tanks V-13 and V-14 General Arrangement

Number of sheets = 1



WEST ELEVATION

ITEM	SIZE	PRESS.	SERVICE	MAT'L.
A	3"	150#	LLI CONN.	STL.
B	4"	150#	INLET	STL.
C	4"	150#	INLET	ST'L.
D	36"	150#	MANHOLE - w/BLIND FLG.	ST'L
E	6"	150#	VENT	ST'L.
F	6"	150#	SPARE	ST'L.

NOTE:
PROJECTION OF ALL FLGD. NOZZLES SHALL BE 6" UNLESS OTHERWISE SHOWN.
VESSEL SHALL BE FABRICATED FOR 50,000 CAPACITY.

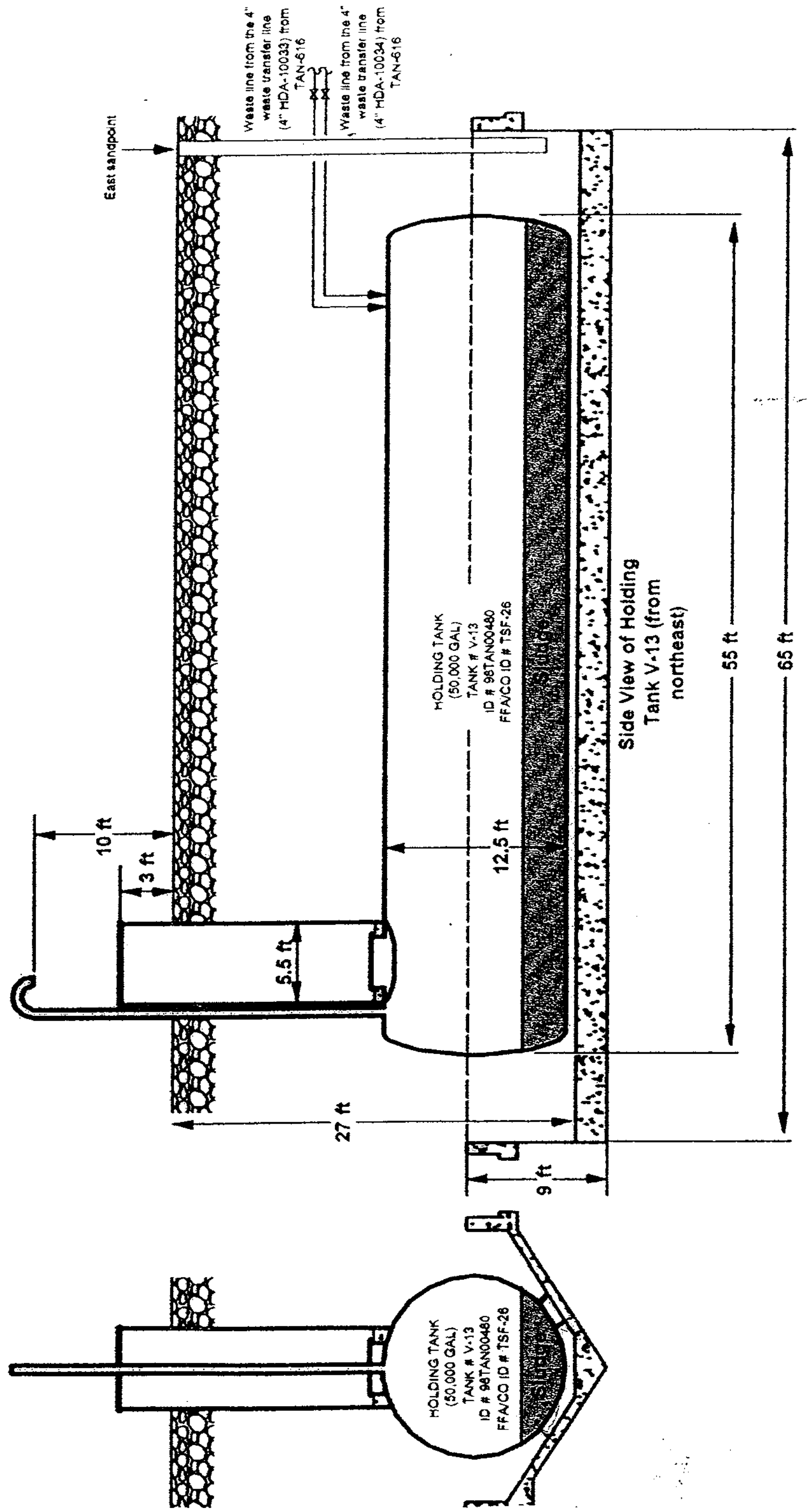
ATTACHMENT NO. – 2

Typical Installed Configuration Details for Holding Tanks V-13 and V-14

Number of sheets = 1

Title: Attachment No. 2

Calc. No. ST- 468 **Rev.** 0 **Sheet** 1 of 1



ATTACHMENT NO. – 3

ANSYS Printout
Load Case: Lifting

Number of sheets = 1

Title: Attachment No. 3		
Calc. No. ST- 468	Rev. 0	Sheet 1 of 1

Load Case: Lifting

The model nodal coordinates, element and material information, boundary condition, nodal and gravity loading along with the nodal, element and the reaction solutions are included in this Attachment.

The following word files are included in the attached diskette under the "Attachment No. 3" directory:

INPUT

File Name	Content
NLIST	Nodal coordinates
ELIST	Element information
ETLIST	Element types
RLIST	Element properties
MPLIST	Material information
FLIST	Nodal Forces
DLIST	Boundary condition
STAT	Inertia load information

OUTPUT

File Name	Content
PRNSOL	Nodal Displacements
PRNSOL STRESS	Nodal Stresses
PRRSOL	Reaction solution

ANSYS RUN: lifting.db

ATTACHMENT NO. – 4

ANSYS Printout
Load Case: Tank on saddles during on-site transportation
(Unprocessed Waste load case)

Number of sheets = 1

Title: Attachment No. 4		
Calc. No. ST- 468	**Rev.** 0	**Sheet** 1 of 1

Load Case: Tank on saddles during on-site transportation

The model nodal coordinates, element and material information, boundary condition, gravity loading along with the nodal, element and the reaction solutions are included in this Attachment.

The following word files are included in the attached diskette under the "Attachment No. 4" directory:

INPUT

File Name	Content
NLIST	Nodal coordinates
ELIST	Element information
ETLIST	Element types
RLIST	Element properties
MPLIST	Material information
DLIST	Boundary condition
STAT	Inertia load information

OUTPUT

File Name	Content
PRNSOL	Nodal Displacements
PRNSOL STRESS	Nodal Stresses
PRRSOL	Reaction solution

ANSYS RUN: onSaddleunp.db

ATTACHMENT NO. – 5

ANSYS Printout
Load Case: Tank on saddles during decontamination and decommissioning
(Processed Waste load case)

Number of sheets = 1

Load Case: Tank on saddles during decontamination and decommissioning

The model nodal coordinates, element and material information, boundary condition, gravity loading along with the nodal, element and the reaction solutions are included in this Attachment.

The following word files are included in the attached diskette under the "Attachment No. 5" directory:

INPUT

File Name	Content
NLIST	Nodal coordinates
ELIST	Element information
ETLIST	Element types
RLIST	Element properties
MPLIST	Material information
DLIST	Boundary condition
STAT	Inertia load information

OUTPUT

File Name	Content
PRNSOL	Nodal Displacements
PRNSOL STRESS	Nodal Stresses
PRRSOL	Reaction solution

ANSYS RUN: onSaddlep.db

433.21
03/10/2004
Rev. 02

MOBILE CRANE LIFT PLAN

LOCATION: TAN - INEEL　　DATE OF LIFT: ______

LOAD DESCRIPTION: 2 - 55' TANKS

LIFT DESCRIPTION: LIFT OUT OF GROUND ONTO TRAILER FOR TRANSPORT

ORDINARY: ______

CRITICAL: YES　　CLPIC: ______ (Signature)

MULTIPLE CRANE: NO

A. CRANE

1. Type of Crane MANITOWOC 2250 W/MAXER 2000
2. Crane Capacity 500 tons; ______ tons
3. Lifting Arrangement

	Crane #1	Crane #2
a. Center of Load To Crane Center Pin	90 ft.	______ ft.
b. Length of Boom	140 ft.	______ ft.
c. Angle of Boom	64.7 deg.	______ deg.
d. Rated Capacity (Reeved to 7 Parts of Line) (From Chart)		
1) Over Rear	231,800 lbs.	______ lbs.
2) Over Front	231,800 lbs.	______ lbs.
3) Over Side	231,800 lbs.	______ lbs.

B. JIB

Erected ______ Stowed NA

1. Length of JIB ______
2. Rated/Capacity of JIB (From Chart) ______

C. CRANE PLACEMENT

1. Electrical Hazards in Area? RECOGNIZED
2. Obstacles or Obstructions to Lift or Swing?
   NO
3. Swing Direction and Degree (Boom Swing)
   WEST TO SOUTH, 90 DEGREES

E. RIGGING

1. Sling Selection
   a. Type SEE DRA. C-067-RP0003-008
   b. Number of Slings in Hook-Up "
   c. Sling Size "
   d. Sling Length "
   e. Rating Capacity of Sling "
2. Shackle Selection
   a. Capacity " tons
   b. Number of Shackles "

F. LOAD DEDUCTIONS

1.	Weight of Headache Ball		lbs.
2.	Weight of Block	6,258	lbs.
3.	Weight of Spreader Beam	2,603	lbs.
4.	Weight of Slings and Shackles	2,033	lbs.
5.	Weight of Jib (____ Erect ____ Stowed)		lbs.
6.	Weight of Cable (Load Fall)	2,200	lbs.
7.	Load Weight	118,000	lbs.
8.	Other	28,250	lbs.
	TOTAL WEIGHT	159,344	lbs.

G. PRE-LIFT CHECKLIST

		YES	NO
1.	Outriggers Fully Extended	☐	☐
2.	Crane Inspection Records	☐	☐
3.	Swing Room	☐	☐
4.	Head Room Checked	☐	☐
5.	Tag Line Used	☐	☐
6.	Load Chart in Crane	☐	☐
7.	Work Area Barricaded or Guarded	☐	☐

8. Wind Conditions ______
9. Qualified Operator ______
10. Qualified Rigger ______
11. Designated Signaler ______

SPECIAL INSTRUCTIONS OR RESTRICTIONS FOR CRANE, RIGGING, LIFT, ETC.

______ Signature of Job Supervisor　DATE: ______

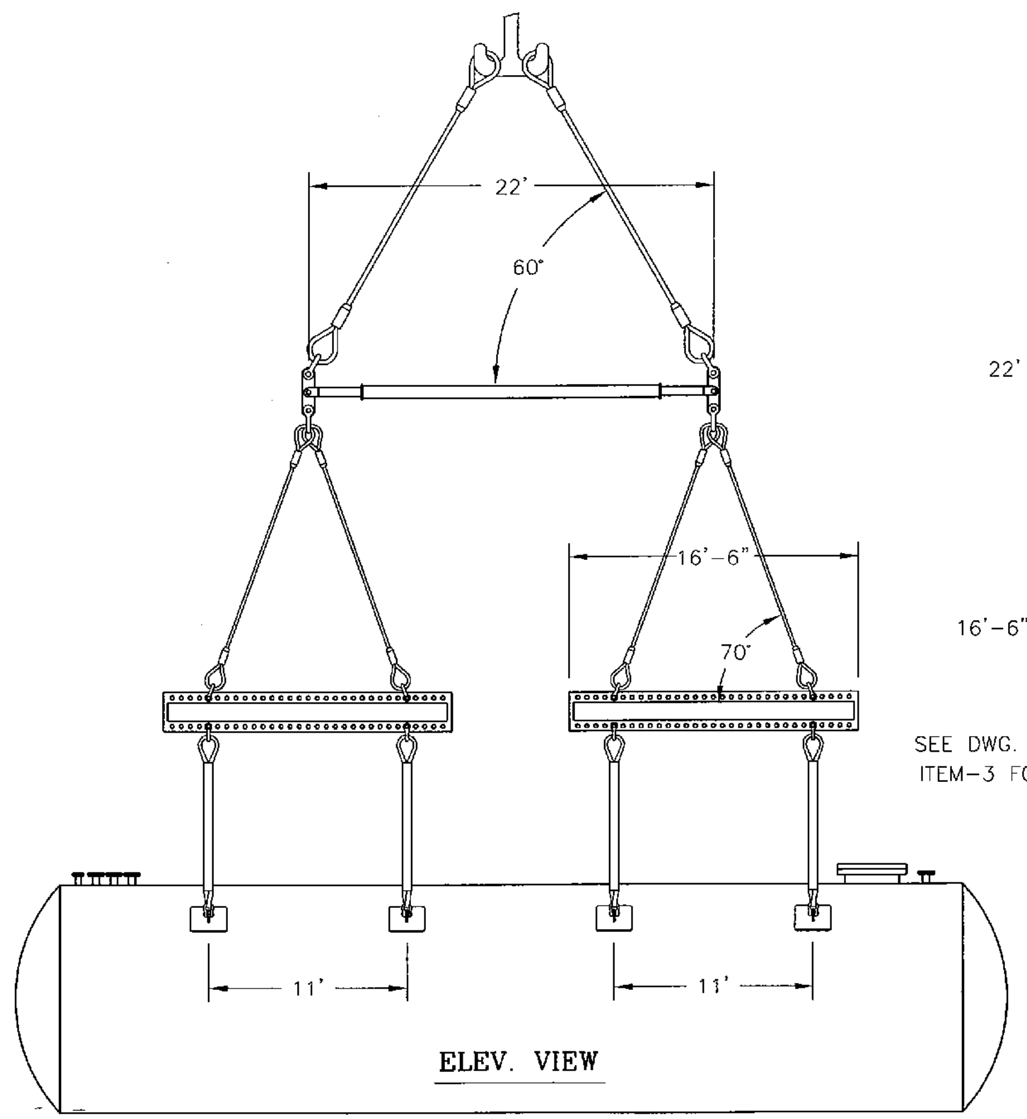
______ Signature - Plan Checked By SME / Safety　DATE: ______

Rigging Configuration On Second Page

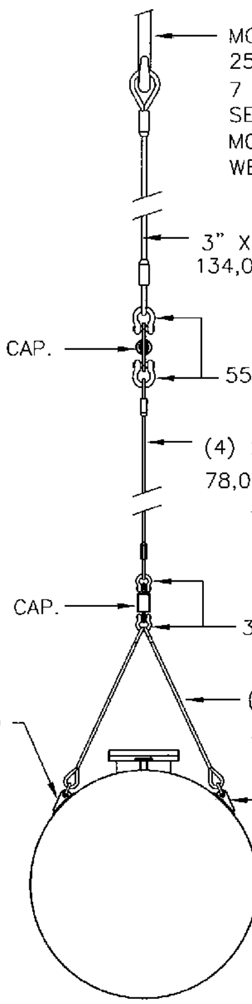
MOBILE CRANE LIFT PLAN

RIGGING CONFIGURATION/CRANE AND LOAD PLACEMENT DIAGRAM

See Drawing C-067-RP0003-008



ELEV. VIEW



SIDE VIEW

GENERAL NOTES:

1: ALL DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

2: THE DESIGN OF THE DURATEK SERVICES, INC. SUPPLIED EQUIPMENT RELIES ON INFORMATION SUPPLIED BY THIRD PARTIES PERTAINING TO THE CONDITION OF THE PM-2A TANKS AND THE LOCAL SITE CONDITIONS

3: SUPPORTING CALCULATIONS ARE PROVIDED IN DURATEK STRUCTURAL CALCULATIONS ST-464, ST-467 AND ST-468

Certification

I, Mirza I. Baig, a licensed Professional Engineer in the state of New Jersey (License No. 24GE02674000), experienced in the design of structural components, certify that the design of the Duratek Services, Inc. supplied equipment is based on sound engineering practices that have been applied for numerous years in the nuclear waste industry. This equipment has been designed and analyzed by engineers proficient in structural engineering and have performed the work under my supervision.

STATE OF NEW JERSEY MIRZA I. BAIG No. 26740 LICENSED PROFESSIONAL ENGINEER

☐ PROPRIETARY
☒ NON-PROPRIETARY

TOLERANCES (UNLESS NOTED)
HOLE DIA. & LOC. ±1/32 DEC. .X ±.1
DEC. .XX ±.01 DEC. .XXX ±.005
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REVIEWERS OF ORIGINAL (REV. 0)

DRAWN BY	R.BREHEN	05/12/04
CHECKED BY	M.ROZINSKI	05/12/04
ENGINEER	J.GHITA	05/12/04

Duratek™

INEEL PM-2A TANK
TANK LIFTING
DETAILS

SIZE	DRAWING NUMBER	REV.
B	C-067-RP0003-008	2

SCALE 1/100 WT. N/A SHEET 1 OF 1

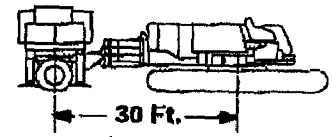
Manitowoc Cranes, Inc.
Manitowoc, Wisconsin 54220 U.S.A.

Liftcrane Boom Capacities

Meets ANSI B30.5 Requirements

MAX-ER 2000 On 2250

Boom No. 79 with 130 Ft. Mast No. 44
169,200 Lb. Crane Counterweight
60,000 Lb. Carbody Counterweight
0 Lb. Thru 462,000 Lb. Wheeled Counterweight at 30 Ft. Position
360 Degree Rating



LIFTING CAPACITIES: Lifting capacities for various boom lengths and operating radii are for freely suspended loads and do not exceed 75% of a static tipping load. Capacities based on structural competence are denoted by an asterisk (*).

Wheeled counterweight must be attached to support beam and MAX-ER mode must be selected to operate. Swing and travel (forward or side crawl) requires proper position of counterweight wheels when contacting ground. Exit MAX-ER mode before operating without wheeled counterweight.

Upper boom point capacity for liftcrane service with single part whip line is 27,700 Lbs. or 55,400 Lbs. with two part whip line. When luffing hoist for 7/8 in. wire rope is used, capacity is 20,000 Lbs. with single part whip line or 40,000 Lbs. with two part whip line. In all cases, upper boom point capacities cannot exceed those listed for main boom capacities.

Weight of all load blocks, hooks, weight ball, slings, hoist lines, etc., beneath boom point sheaves, is considered part of main boom load. Boom is not to be lowered beyond radii where combined weights are greater than rated capacity. Where no capacity is shown, operation is not intended or approved.

OPERATING CONDITIONS: Machine to operate on a firm uniformly supporting surface with gantry in intermediate position and mast up. Refer to boom rigging No. 194041, Wire Rope Specification chart No. 8189-A and Counterweight Arrangement chart No. 8412-A. Crane operator judgment must be used to allow for dynamic load effects of swinging, hoisting or lowering, travel, wind conditions, as well as adverse operating conditions and physical machine depreciation. Refer to operators manual for operating guidelines.

MACHINE TRAVEL: Machine to travel on a firm, level and uniformly supporting surface with boom within boom angle range shown in capacity chart. Travel may be limited depending upon ground conditions. Refer to Maximum Allowable Travel Specification chart No. 8190-A when operating without load.

OPERATING RADIUS: Operating radius is horizontal distance from axis of rotation to center of vertical hoist line or load block. Boom angle is angle between horizontal and centerline of boom butt and inserts, and is an indication of operating radius. In all cases, operating radius shall govern capacity.

BOOM POINT ELEVATION: Boom point elevation is vertical distance from ground level to centerline of boom point shaft.

MACHINE EQUIPMENT: Machine equipped with MAX-ER 2000, 30 Ft. 9 in. crawlers, 48 in. treads, 28 Ft. retractable gantry, 130 Ft. mast, 10 part boom hoist reeving, boom support straps, 169,200 Lb. crane counterweight, two 30,000 Lb. carbody counterweights and wheeled counterweight as specified.

WARNING: Check amount of wheeled counterweight on machine before use of this chart. Refer to Counterweight Assembly.

Maximum Boom Lengths Lifted Unassisted		
Over End of Blocked Crawlers	Over End of Unblocked Crawlers	Over Side of Crawlers
Boom Length	Boom Length	Boom Length
0 Lb. Wheeled Counterweight		
220 Ft.	200 Ft.	200 Ft.
120,000 Lb. Wheeled Counterweight		
260 Ft.	260 Ft.	260 Ft.
240,000 Lb. Wheeled Counterweight		
320 Ft.	300 Ft.	300 Ft.
362,000 Lb. Wheeled Counterweight		
360 Ft.	340 Ft.	340 Ft.
462,000 Lb. Wheeled Counterweight		
360 Ft.	360 Ft.	360 Ft.
Load block, hook and weight ball on ground at start.		

S/N: 2253135

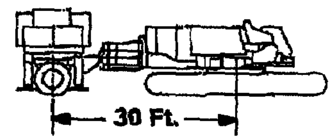
Manitowoc Cranes, Inc.
Manitowoc, Wisconsin 54220 U.S.A.

Liftcrane Boom Capacities

Meets ANSI B30.5 Requirements

MAX-ER 2000 On 2250

Boom No. 79 with 130 Ft. Mast No. 44
169,200 Lb. Crane Counterweight
60,000 Lb. Carbody Counterweight
0 Lb. Thru 462,000 Lb. Wheeled Counterweight at 30 Ft. Position
360 Degree Rating



Oper. Rad. Feet	Boom Ang. Deg.	Boom Point Elev. Feet	0 Lb. Wheeled Counterweight Boom Capacity Pounds	120,000 Lb. Wheeled Counterweight Boom Capacity Pounds	240,000 Lb. Wheeled Counterweight Boom Capacity Pounds	362,000 Lb. Wheeled Counterweight Boom Capacity Pounds	462,000 Lb. Wheeled Counterweight Boom Capacity Pounds	Oper. Rad. Feet
140 Ft. Boom								
28	82.6	148.4	406,900 *	511,300 *	608,500 *	707,300 *	785,900 *	28
30	81.8	148.0	380,400 *	478,600 *	570,100 *	663,100 *	734,600 *	30
32	80.9	147.7	356,800 *	449,500 *	536,000 *	623,800 *	689,400 *	32
34	80.1	147.3	335,600 *	423,500 *	505,400 *	587,200 *	649,100 *	34
36	79.3	146.8	306,200	400,100 *	477,900 *	554,500 *	613,100 *	36
38	78.4	146.3	280,700	378,900 *	453,000 *	525,000 *	580,700 *	38
40	77.6	145.8	258,700	359,600 *	430,400 *	498,300 *	551,400 *	40
45	75.4	144.5	215,200	318,300 *	381,900 *	441,500 *	489,000 *	45
50	73.3	142.9	183,000	284,700 *	342,300 *	395,600 *	438,500 *	50
55	71.1	141.1	158,100	249,600	309,400 *	357,700 *	396,900 *	55
60	68.9	139.1	138,300	220,500	281,700 *	325,900 *	361,900 *	60
65	66.7	136.8	122,200	196,700	257,900 *	298,900 *	332,200 *	65
70	64.4	134.3	108,900	177,000	237,400 *	275,600 *	306,600 *	70
75	62.1	131.6	97,600	160,300	218,800	255,300 *	284,200 *	75
80	59.7	128.6	87,900	146,100	200,300	237,400 *	264,600 *	80
85	57.2	125.3	79,600	133,800	184,300	221,600 *	247,300 *	85
90	54.7	121.6	72,300	123,100	170,400	207,500 *	231,800 *	90
95	52.1	117.6	65,800	113,600	158,100	194,900 *	217,900 *	95
100	49.4	113.3	60,100	105,100	147,100	183,400 *	205,300 *	100
105	46.5	108.4	54,900	97,600	137,400	173,100 *	193,900 *	105
110	43.5	103.1	50,300	90,800	128,600	163,600 *	183,500 *	110
115	40.3	97.1	46,100	84,700	120,600	154,900 *	174,000 *	115
120	36.9	90.4	42,300	79,100	113,300	147,000 *	165,300 *	120
125	33.2	82.7	38,800	73,900	106,700	139,600 *	157,200 *	125
130	28.9	73.7	35,600	69,200	100,600	132,500	149,700 *	130
135	24.0	62.7	32,500	64,900	95,000	125,600	142,700 *	135
140	17.7	48.1	29,700	60,800	89,700	119,100	136,100 *	140

S/N: 2253135

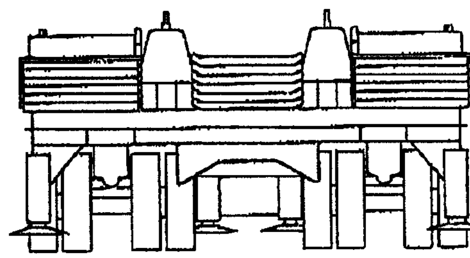
Manitowoc Cranes, Inc.
Manitowoc, Wisconsin 54220 U.S.A.

Counterweight Arrangements

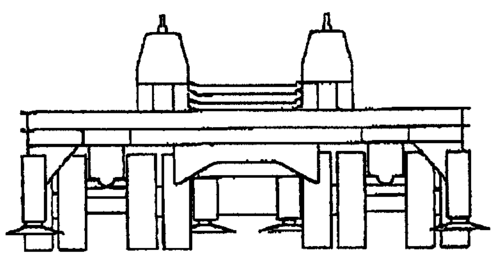
MAX-ER 2000 On 2250

Wheeled Counterweight Assembly with Flat Boxes
No. 195826

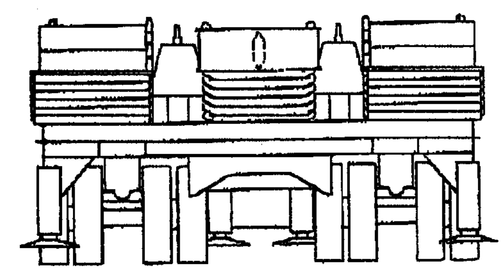
0 Lb. (0 kg) Wheeled Counterweight



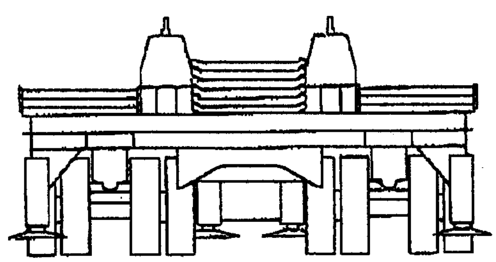
362,000 Lb. (164 200 kg) Wheeled Counterweight
14 Side Boxes With 4 Adapter Plates
6 Center Boxes



120,000 Lb. (54 430 kg) Wheeled Counterweight
3 Center Boxes



462,000 Lb. (209 560 kg) Wheeled Counterweight
16 Side Boxes With 4 Adapter Plates
10 Center Boxes



240,000 Lb. (108 860 kg) Wheeled Counterweight
6 Side Boxes - 6 Center Boxes

Refer to Counterweight Assembly for box weights.

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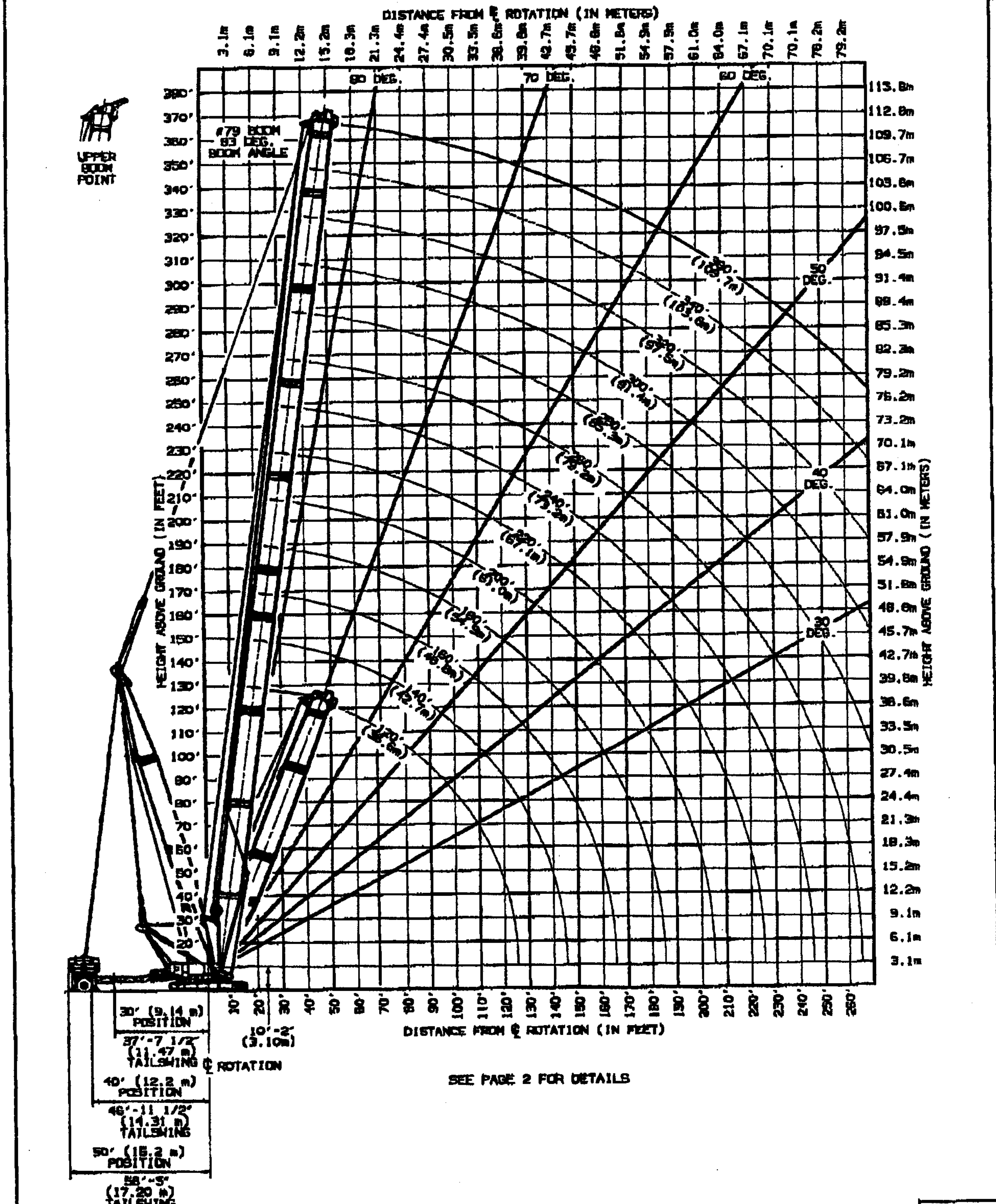
MANITOWOC CRANES, INC.



RANGE DIAGRAM - 2250 MAX-ER 2000 (#79 BOOM)

S/N: 2253135

Table of Contents

General

Wind adversely affects lifting capacity and stability as shown in Figure 1. The result could be loss of control over the load and crane, even if the load is within the crane's capacity.

WARNING

TIPPING CRANE HAZARD! Judgment and experience of qualified operators, job planners, and supervisors must be used to compensate for affect of wind on lifted load and boom by reducing ratings, reducing operating speeds, or a combination of both.

Failing to observe this precaution can cause crane to tip or boom and/or jib to collapse. Death or serious injury to personnel can result.

Wind speed (to include wind gusts) must be monitored by job planners and supervisors.

Beware that wind speed at the boom or jib point can be greater than wind speed at ground level. Also beware that the larger the sail area of the load, the greater the wind's affect on the load.

As a general rule, ratings and operating speeds must be reduced when:

Wind causes load to swing forward past allowable operating radius or sideways past either boom hinge pin.

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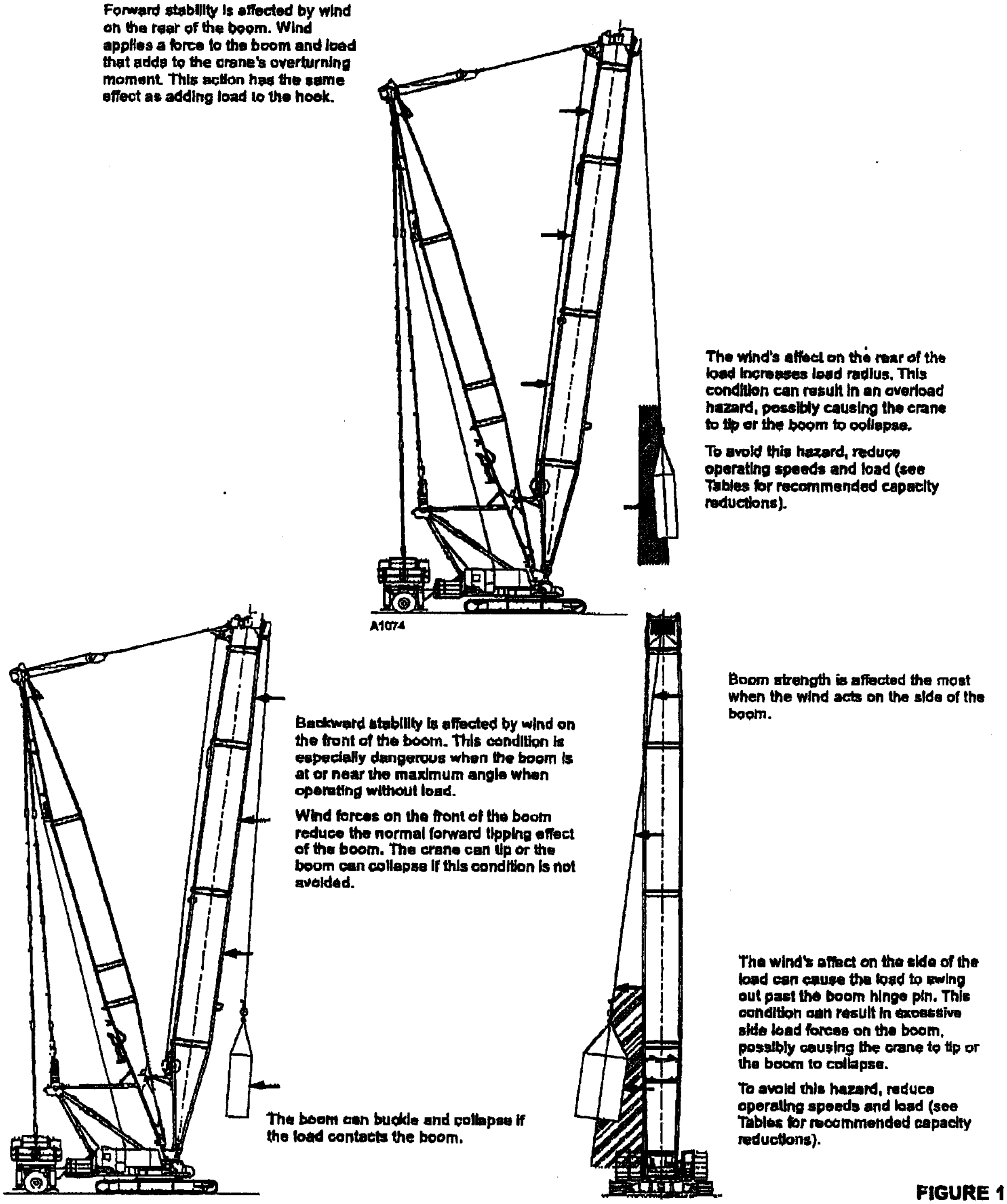

FIGURE 1

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Manitowoc Recommendations

Operation Permitted

Operation is permitted in steady winds or wind gusts up to 35 mph (16 m/s). However, ratings must be reduced the amount given in the following tables for the corresponding attachment.

Table 1
Rating Reductions for Various Wind Speeds and Wind Gusts
WHEN EQUIPPED WITH #79 BOOM

Boom Length ft (m)		120–240 (36.6–73.2)	260–300 (79.2–91.4)	320–340 (97.5–103.6)	360 (109.7)
Maximum Wind Speed		Percent Rating Reduction			
mph	m/s				
15	7	0	0	0	0
20	9	0	0	10	10
25	11	0	10	20	20
30	13	0	10	20	30
35	16	0	20	30	50
Above 35 mph (16 m/s)		OPERATION NOT PERMITTED			

Table 2
Rating Reductions for Various Wind Speeds and Wind Gusts
WHEN EQUIPPED WITH #79-44 BOOM

Boom Length ft (m)		200–240 (61.0–73.2)	260–300 (79.2–91.4)	320–360 (97.5–109.7)	380–400 (115.8–121.9)
Maximum Wind Speed		Percent Rating Reduction			
mph	m/s				
15	7	0	0	0	0
20	9	0	0	10	20
25	11	0	10	20	30
30	13	0	10	30	50
35	16	0	20	50	
Above 35 mph (16 m/s)		OPERATION NOT PERMITTED			

S/N: 2253135

Operation Not Permitted

NOTE: For special conditions not covered below, contact Technical Services Department at factory.

#79 Boom Only

- **Up to 50 mph (22 m/s)** — Park crane (upper in line with crawlers) with load block on ground or secured and position boom no higher than 75°.
- **Above 50 mph (22 m/s)** — Lower boom onto blocking at ground level.

#79-44 Boom
200 – 360' (61.0 – 109.7 m)

- **Up to 50 mph (22 m/s)** — Park crane (upper in line with crawlers) with load block on ground or secured and position boom at 70°.
- **Above 50 mph (22 m/s)** — Lower boom onto blocking at ground level.

#79-44 Boom
380 – 400' (115.8 – 121.9 m)

- **Up to 40 mph (18 m/s)** — Park crane (upper in line with crawlers) with load block on ground or secured and position boom at 70°.
- **Above 40 mph (18 m/s)** — Lower boom onto blocking at ground level.

#79-44 Boom and #132 Fixed Jib
Up to 400' (121.9 m) Combined Length

- **Up to 50 mph (22 m/s)** — Park crane (upper in line with crawlers) with load block on ground or secured and position boom at 75°.
- **Above 50 mph (22 m/s)** — Lower boom and jib onto blocking at ground level.

#79-44 Boom and #132 Fixed Jib
420' (128.0 m) and Greater Combined Length

- **Up to 35 mph (16 m/s)** — Park crane (upper in line with crawlers) with load block on ground or secured and position boom at 75°.
- **Above 35 mph 16 m/s)** — Lower boom and jib onto blocking at ground level.

#79 Boom with #44 Luffing Jib

- **Up to 50 mph (22 m/s)** — Park crane (upper in line with crawlers) with load block on ground or secured and position boom at 75° and luffing jib at 50°.
- **Above 50 mph (22 m/s)** — Lower boom and jib onto blocking at ground level.

#79 Boom with #44 Fixed Jib

- **Up to 50 mph (22 m/s)** — Park crane (upper in line with crawlers) with load block on ground or secured and position boom at 75°.
- **Above 50 mph (22 m/s)** — Lower boom and jib onto blocking at ground level.

S/N: 2253135